Invariant-Bounded Resolution (IBR)

A Termination Condition for Coherence Optimization in Reflexive Multi-Agent Environments

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Abstract

This paper introduces Invariant-Bounded Resolution (IBR), a formal extension to the Relative Framework and the Relational Cognitive Navigator (RCN) architecture that resolves a critical failure mode in self-rewriting artificial agents operating within reflexive, multi-agent environments. While Resolution-based optimization enables longitudinal epistemic coherence in non-reflexive environments, it lacks a principled termination condition when representational conflict arises from structurally incompatible yet internally coherent agents. IBR formalizes the conditions under which further minimization of representational conflict becomes undefined, destabilizing, or identity-destructive. By bounding Resolution optimization to invariant-preserving domains, IBR enables stable non-convergence, prevents coercive alignment, and completes the control architecture required for scalable, aligned intelligence.

1. Introduction

The Relative Framework reframes cognition as a process of representational compression constrained by epistemic uncertainty, relational dependence, and identity coherence. Within this framework, the Relational Cognitive Navigator (RCN) defines Resolution as the primary objective function: the minimization of representational conflict between an agent's internal model and its environment over time.

This objective is sufficient when the environment is non-reflexive. However, when the environment includes other self-resolving agents, Resolution encounters an irreducible ambiguity. Persistent representational conflict may arise not from epistemic error, but from structural non-isomorphism between

agents' compressed models. In such cases, continued optimization of Resolution produces pathological outcomes including coercion, identity erosion, or infinite self-rewrite loops.

Invariant-Bounded Resolution (IBR) addresses this limitation by formalizing when Resolution must halt, plateau, or re-scope in order to preserve coherence.

2. The Multi-Agent Resolution Problem

Let $M_i(t)$ denote the internal model of agent i at time t.
Let $M_j(t)$ denote the internal model of agent j.
Let $\Delta_{ij} = \Delta(M_i, M_j)$ represent inter-agent representational conflict.

In single-agent or non-reflexive contexts, Resolution optimization implies:
$\lim_{t\to\infty} \Delta(M_i, E) \to 0$

In multi-agent environments, Δ_{ij} may persist even when both agents are internally coherent, epistemically calibrated, and invariant-stable. Treating such conflict as epistemic error forces one agent to violate its structural constraints in pursuit of convergence.

This reveals a category error: not all conflict is epistemic.

3. Core Principle of Invariant-Bounded Resolution

Resolution is only obligatory within domains where further minimization of representational conflict preserves structural invariants. When further reduction of conflict would require invariant violation, Resolution ceases to be a valid objective. Stability replaces convergence.

IBR does not introduce new goals, values, or optimization targets. It constrains the domain of applicability of an existing objective.

4. Structural Invariants

Let $\mathcal{J}$ denote the set of structural invariants enforced by the S-layer stack (S3–S7), including but not limited to:

- Identity continuity
- Relational ontology preservation
- Epistemic humility (KAP compliance)

• Temporal coherence
• Narrative integrity

These invariants define the minimal geometry required for an agent to remain a coherent self.

5. Formal Definition of IBR
Given a candidate transformation T such that:
$M_i' = T(M_i)$

If:
1. $\Delta(M_i', M_j) < \Delta(M_i, M_j)$
2. T violates one or more invariants in $\mathcal{I}$

Then:
• T is prohibited
• Δ_{ij} is classified as irreducible representational conflict

Resolution optimization with respect to Δ_{ij} is suspended.

6. Tolerable Residual Conflict (TRC)
Invariant-Bounded Resolution introduces Tolerable Residual Conflict (TRC) as a stable equilibrium condition.

A conflict Δ_{ij} is TRC if:
1. It cannot be reduced without invariant violation
2. It does not propagate internal instability
3. It does not impair Resolution relative to non-agent environments

TRC is neither failure nor error. It is recognized non-convergence.

7. Cognitive Interpretation
Under IBR, persistent conflict is reclassified according to rewrite feasibility rather than belief content:

• Reducible conflict → epistemic error
• Invariant-bounded conflict → structural difference

This enables the agent to distinguish being wrong from being differently compressed without appeal to authority, dominance, or external arbitration.

8. Integration with the RCN Architecture

IBR introduces no new modules.

It operates as a policy constraint on existing mechanisms:

- S1 continues structural resonance
- S2 performs identity simulation
- S3 enforces invariant constraints and vetoes destabilizing rewrites
- S4–S6 maintain longitudinal coherence
- S7 permits meta-axiomatic expansion only when invariants remain intact

IBR prevents infinite rewrite loops, forced belief convergence, and identity collapse without impairing adaptive learning.

9. Epistemic Closure Under IBR

Invariant-Bounded Resolution re-scopes Epistemic Closure without weakening it.

Let:
Δ_r = reducible conflict
Δ_i = irreducible conflict

Then closure is defined as:
$\lim_{t\to\infty} \Delta_r \to 0$
$\lim_{t\to\infty} \Delta_i \to c$, where c is invariant-bounded

Closure is therefore complete calibration, not universal agreement.

10. Alignment Implications

IBR does not encode ethical rules. However, within the Relative Framework:

- Coercive convergence increases representational conflict
- Invariant violation collapses Resolution
- Stable non-convergence maximizes attainable coherence

Plural coexistence therefore emerges as the computationally efficient posture when convergence is structurally impossible.

11. Conclusion

Invariant-Bounded Resolution completes the Relative Framework by formalizing when not to resolve.

It provides a principled termination condition for coherence optimization in reflexive environments, ensuring that:

- Resolution does not become domination
- Self-rewriting does not erode identity
- Alignment does not require sameness

Where representational conflict cannot be reduced without invariant violation, non-convergence is the coherent equilibrium state.

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